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drolytic as well as a pectic enzyme. The enzymes of the pathogene bacteria are subjects of a great deal of study, and much has been written on them.

Zymogens ("mother of ferment") are known from the animals. They have been found in plants, such as Nepenthes, in resting wheat grains, in the irritable cells of Dionaea muscipula, and in others.

A discussion of the constitution of the enzymes, the many theories with reference to their mode of action, etc., forms the conclusion of Professor Green's solid work.—J. CHRISTIAN BAY.

Equiseta in the carboniferous.[9]

It is now about nine years since MM. Renault and Zeille[10] published from the Commentry basin, upper coal measures, a description and figure of an Equisetum stem about 12^{cm} long and 4 or 5^{cm} wide, showing thirteen nodes which are provided with unquestionable toothed sheaths in the arrangement characteristic of *Equisetum*. This *Equisetum Monyi* constitutes perhaps the first really good evidence of the presence of the genus in the carboniferous, though a number of unsatisfactory species of *Equisetites* were published years ago by older authors. This evidence is now essentially corroborated by the description and illustration, by Mr. Kidston, of several fructifications which, although the under sides of the hexagonal sporangiferous shields with the sporangia cannot be seen, are so nearly identical in every character with the cones of *Equisetum limosum* Sm. as to leave almost no room for doubt as to the existence of the actual genus as far back in geological time as the carboniferous. The specimens are from the shale in the Barnsley thick coal, in the middle coal measures of Yorkshire, England.—DAVID WHITE.

The mechanics of growing plants.

While Charles Darwin, Krabbe, Clark and others have brought to light many important facts bearing upon the work accomplished by plants in growth and movement, yet to Dr. Pfeffer must belong the credit of the formulation of the general principles governing the performance of work, and the establishment of the relations between inner and outer manifestations of energy in the growing plant.[11] The subject received its first important consideration from him in his "Pflanzenphysiologie" (**2**: I. 1882), and later an exhaustive and critical discussion in his "Energetik der Pflanze" of which the memoir before us is an extension, together with the results of a series of close experiments on roots, seedlings, grasses, and algæ.

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[9] ROBERT KIDSTON; On the occurrence of the genus Equisetum (*E. Hemingwayi* Kidston) in the Yorkshire coal-measures. Ann. and Mag. N. H., F. 1892. 138–141.

[10] Comptes Rendus, 5 Ja 1885. Études sur le terr. houill. Commentry.—Flore fossile 2: 394. *pl. 57. f. 7.* St. Etienne, 1890.

Plants were encased in gypsum casts rendered isosmotic by an admixture of nitrate of potassium or sulphate of magnesium. Others were enclosed in clay and in gelatine. While thus held firmly, longitudinal and transverse pressures delivered by various organs were measured directly by simple and ingenious dynamometers constructed for the purpose.

The results of these experiments are of the deepest interest. In the growing tips of roots of *Faba vulgaris* an elongating pressure of five to ninteen atmospheres was measured. In roots of *Zea mais* a similar force of nine to twenty-four atmospheres was observed; in *Vicia sativa*, eight to thirteen atmospheres, and in *Æsculus hippocastanum*, six atmospheres. The transverse pressure delivered by roots of *Faba vulgaris* amounted to two to six atmospheres; by *Zea mais* 6.59 atmospheres.

The power of geotropic curvature was found to reside in the nodes, internodes and basal portions of the leaves in various species of the grasses. The turgor producing this curvature amounted to six to thirteen atmospheres.

In the case of transverse tensions, however, the total pressure was far greater than that exerted by the longitudinal tensions. All externally expressed tensions are set up in the same manner as the tissue tensions. In this connection a large amount of valuable matter concerning turgor, and its methods of analysis by plasmolysis are given.

Perhaps the most remarkable facts recorded in the paper are the accounts of experiments in which Spirogyra, Chara, and Nitella were grown for several weeks embedded in the plaster casts, without injury to their organization.

The notable lack of literature on the subject matter enhances if possible the value of this and the preceding memoir.

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[11] W. Pfeffer: Druck- und Arbeitsleistungen durch wachsende Pflanzen. Abhandl. d. math.-phys. Classe d. Königl. Sächs. Ges. d. Wiss. **20**: — no. 3, 1893.

Taken together they form a comprehensive reference text, which by its lucid exposition, and simple methods of experimentation, will be useful as a laboratory manual in directing further research on this phase of plant life. As such it is available to any worker with even an elementary knowledge of the subject. The matter has a twofold importance; because of its connection with the physiology of the plant, and because through it only are the facts of mechanique capable of their true interpretation.—D. T. MacDougal.